Indiana's academic standards for science contain six standards. Each standard is described below. On the pages that follow, age-appropriate concepts are listed underneath each standard. These ideas build a foundation for understanding the intent of each standard.

Standard 1 — The Nature of Science and Technology

It is the union of science and technology that forms the scientific endeavor and that makes it so successful. Although each of these human enterprises has a character and history of its own, each is dependent on and reinforces the other. This first standard draws portraits of science and technology that emphasize their roles in the scientific endeavor and reveal some of the similarities and connections between them. In order for students to truly understand the nature of science and technology, they must model the process of scientific investigation through inquiries, fieldwork, lab work, etc. Through these experiences, students will practice designing investigations and experiments, making observations, and formulating theories based on evidence.

Standard 2 — Scientific Thinking

There are certain thinking skills associated with science, mathematics, and technology that young people need to develop during their school years. These are mostly, but not exclusively, mathematical and logical skills that are essential tools for both formal and informal learning and for a lifetime of participation in society as a whole. Good communication is also essential in order to both receive and disseminate information and to understand others' ideas as well as have one's own ideas understood. Writing, in the form of journals, essays, lab reports, procedural summaries, etc., should be an integral component of students' experiences in science.

Standard 3 — The Physical Setting

One of the grand success stories of science is the unification of the physical universe. It turns out that all natural objects, events, and processes are connected to each other. This standard contains recommendations for basic knowledge about the overall structure of the universe and the physical principles on which it seems to run, with emphasis on Earth and the solar system. This standard focuses on two principle subjects: the structure of the universe and the major processes that have shaped planet Earth, and the concepts with which science describes the physical world in general – organized under the headings of *Matter and Energy* and *Forces of Nature*. In Grade 4, students learn that the properties of rocks reflect the processes that formed them. They investigate force and energy.

Standard 4 — The Living Environment

People have long been curious about living things – how many different species there are, what they are like, how they relate to each other, and how they behave. Living organisms are made of the same components as all other matter, involve the same kinds of transformations of energy, and move using the same basic kinds of forces. Thus, all of the physical principles discussed in Standard 3 – The Physical Setting, apply to life as well as to stars, raindrops, and television sets. This standard offers recommendations on basic knowledge about how living things function and how they interact with one another and their environment. In Grade 4, students learn that all organisms need energy and matter to live and grow.

Standard 5 — The Mathematical World

Mathematics is essentially a process of thinking that involves building and applying abstract, logically connected networks of ideas. These ideas often arise from the need to solve problems in science, technology, and everyday life — problems ranging from how to model certain aspects of a complex scientific problem to how to balance a checkbook.

Standard 6 — Common Themes

Some important themes pervade science, mathematics, and technology and appear over and over again, whether we are looking at ancient civilization, the human body, or a comet. These ideas transcend disciplinary boundaries and prove fruitful in explanation, in theory, in observation, and in design. A focus on *Constancy and Change* within this standard provides students opportunities to engage in long-term and on-going laboratory and fieldwork, and thus understand the role of change over time in studying The Physical Setting and The Living Environment.

Standard 1

The Nature of Science and Technology

Students, working collaboratively, carry out investigations. They observe and make accurate measurements, increase their use of tools and instruments, record data in journals, and communicate results through chart, graph, written, and verbal forms.

The Scientific View of the World

4.1.1 Observe and describe that scientific investigations generally work the same way in different places.

Scientific Inquiry

4.1.2 Recognize and describe that results of scientific investigations are seldom exactly the same. If differences occur, such as a large variation in the measurement of plant growth, propose reasons for why these differences exist, using recorded information about investigations.

The Scientific Enterprise

4.1.3 Explain that clear communication is an essential part of doing science since it enables scientists to inform others about their work, to expose their ideas to evaluation by other scientists, and to allow scientists to stay informed about scientific discoveries around the world.

4.1.4 Describe how people all over the world have taken part in scientific investigation for many centuries.

Technology and Science

4.1.5 Demonstrate how measuring instruments, such as microscopes, telescopes, and cameras, can be used to gather accurate information for making scientific comparisons of objects and events. Note that measuring instruments, such as rulers, can also be used for designing and constructing things that will work properly.

4.1.6 Explain that even a good design may fail even though steps are taken ahead of time to reduce the likelihood of failure.

4.1.7 Discuss and give examples of how technology, such as computers and medicines, has improved the lives of many people, although the benefits are not equally available to all.

4.1.8 Recognize and explain that any invention may lead to other inventions.

4.1.9 Explain how some products and materials are easier to recycle than others.

Standard 2

Scientific Thinking

Students use a variety of skills and techniques when attempting to answer questions and solve problems. They describe their observations accurately and clearly, using numbers, words, and sketches, and are able to communicate their thinking to others. They compare, explain, and justify both information and numerical functions.*

Computation and Estimation

4.2.1 Judge whether measurements and computations of quantities, such as length, area*, volume*, weight, or time, are reasonable.

4.2.2 State the purpose, orally or in writing, of each step in a computation.

* observation: gaining information through the use of one or more of the senses, such as sight, smell, etc.

* area: a measure of the size of a two-dimensional region

* volume: a measure of the size of a three-dimensional object

Manipulation and Observation

4.2.3 Make simple and safe electrical connections with various plugs, sockets, and terminals.

Communication Skills

4.2.4 Use numerical data to describe and compare objects and events.

4.2.5 Write descriptions of investigations, using observations and other evidence as support for explanations.

Critical Response Skills

4.2.6 Support statements with facts found in print and electronic media, identify the sources used, and expect others to do the same.

4.2.7 Identify better reasons for believing something than "Everybody knows that …" or "I just know," and discount such reasons when given by others.

Standard 3

The Physical Setting

Students continue to investigate changes of Earth and the sky and begin to understand the composition and size of the universe. They explore, describe, and classify materials, motion, and energy*.*

The Universe

4.3.1 Observe and report that the moon can be seen sometimes at night and sometimes during the day.

* motion: the change in position of an object in a certain amount of time
* energy: what is needed to make things move

Earth and the Processes That Shape It

4.3.2 Begin to investigate and explain that air is a substance that surrounds us and takes up space, and whose movements we feel as wind.

4.3.3 Identify salt as the major difference between fresh and ocean waters.

4.3.4 Describe some of the effects of oceans on climate.

4.3.5 Describe how waves, wind, water, and glacial ice shape and reshape Earth's land surface by the erosion* of rock and soil in some areas and depositing them in other areas.

4.3.6 Recognize and describe that rock is composed of different combinations of minerals.

4.3.7 Explain that smaller rocks come from the breakage and weathering of bedrock and larger rocks and that soil is made partly from weathered rock, partly from plant remains, and also contains many living organisms.

4.3.8 Explain that the rotation of Earth on its axis every 24 hours produces the night-and-day cycle.

4.3.9 Draw or correctly select drawings of shadows and their direction and length at different times of day.

* erosion: the process by which the products of weathering* are moved from one place to another
* weathering: breaking down of rocks and other materials on Earth's surface by such processes as rain or wind

Matter* and Energy

4.3.10 Demonstrate that the mass* of a whole object is always the same as the sum of the masses of its parts.

4.3.11 Investigate, observe, and explain that things that give off light often also give off heat*.

4.3.12 Investigate, observe, and explain that heat is produced when one object rubs against another, such as one's hands rubbing together.

4.3.13 Observe and describe the things that give off heat, such as people, animals, and the sun.

4.3.14 Explain that energy in fossil fuels* comes from plants that grew long ago.

* matter: anything that has mass* and takes up space
* mass: a measure of how much matter is in an object
* heat: a form of energy characterized by random motion at the molecular level
* fossil fuels: a fuel, such as natural gas or coal, that was formed a long time ago from decayed plants and animals

Forces of Nature

4.3.15 Demonstrate that without touching them, a magnet pulls all things made of iron and either pushes or pulls other magnets.

4.3.16 Investigate and describe that without touching them, material that has been electrically charged pulls all other materials and may either push or pull other charged material.

Standard 4

The Living Environment

Students learn about an increasing variety of organisms – familiar, exotic, fossil, and microscopic. They use appropriate tools in identifying similarities and differences among them. They explore how organisms satisfy their needs in their environments.

Diversity of Life

4.4.1 Investigate, such as by using microscopes, to see that living things are made mostly of cells.

Interdependence of Life and Evolution

4.4.2 Investigate, observe, and describe that insects and various other organisms depend on dead plant and animal material for food.

4.4.3 Observe and describe that organisms interact with one another in various ways, such as providing food, pollination, and seed dispersal.

4.4.4 Observe and describe that some source of energy is needed for all organisms to stay alive and grow.

4.4.5 Observe and explain that most plants produce far more seeds than those that actually grow into new plants.

4.4.6 Explain how in all environments, organisms are growing, dying, and decaying, and new organisms are being produced by the old ones.

Human Identity

4.4.7 Describe that human beings have made tools and machines, such as x-rays, microscopes, and computers, to sense and do things that they could not otherwise sense or do at all, or as quickly, or as well.

4.4.8 Know and explain that artifacts and preserved remains provide some evidence of the physical characteristics and possible behavior of human beings who lived a very long time ago.

4.4.9 Explain that food provides energy and materials for growth and repair of body parts. Recognize that vitamins and minerals, present in small amounts in foods, are essential to keep everything working well. Further understand that as people grow up, the amounts and kinds of food and exercise needed by the body may change.

4.4.10 Explain that if germs are able to get inside the body, they may keep it from working properly. Understand that for defense against germs, the human body has tears, saliva, skin, some blood cells, and stomach secretions. Also note that a healthy body can fight most germs that invade it. Recognize, however, that there are some germs that interfere with the body's defenses.

4.4.11 Explain that there are some diseases that human beings can only catch once. Explain that there are many diseases that can be prevented by vaccinations, so that people do not catch them even once.

Standard 5

The Mathematical World

Students apply mathematics in scientific contexts. Their geometric descriptions of objects are comprehensive. They realize that graphing demonstrates specific connections between data. They identify questions that can be answered by data distribution.

Numbers

4.5.1 Explain that the meaning of numerals in many-digit numbers depends on their positions.

4.5.2 Explain that in some situations, "0" means none of something, but in others it may be just the label of some point on a scale.

Shapes and Symbolic Relationships

4.5.3 Illustrate how length can be thought of as unit lengths joined together, area as a collection of unit squares, and volume as a set of unit cubes.

4.5.4 Demonstrate how graphical displays of numbers may make it possible to spot patterns that are not otherwise obvious, such as comparative size and trends.

Reasoning and Uncertainty

4.5.5 Explain how reasoning can be distorted by strong feelings.

Standard 6

Common Themes

Students work with an increasing variety of systems and begin to modify parts in systems and models and notice the changes that result. They question why change occurs.

Systems

4.6.1 Demonstrate that in an object consisting of many parts, the parts usually influence or interact with one another.

4.6.2 Show that something may not work as well, or at all, if a part of it is missing, broken, worn out, mismatched, or incorrectly connected.

Models and Scale

4.6.3 Recognize that and describe how changes made to a model can help predict how the real thing can be altered.

Constancy and Change

4.6.4 Observe and describe that some features of things may stay the same even when other features change.